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(54) Malleable, bioabsorbable, plastic staple having a knotted configuration: and method and apparatus for deforming such staple

Aus dehnbarem, bioabsorbierbarem Kunststoff hergestellte Klammer mit verknoteter Konfiguration sowie Verfahren und Gerät zu deren Verformung

Agrafe en matière plastique malléable et bioabsorbable ayant une configuration nouée ainsi que méthode et dispositif pour la déformer

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a surgical staple in accordance with the preamble of claim 1, as known from GB-A-2293903, and to a method and an anvil therefor.

Description of the Prior Art

Historically, suturing of a surgical or other wound in organs and tissue has been done by hand. Conventional hand suturing techniques require a high degree of surgical skill. However, expertise in such techniques can vary widely from surgeon to surgeon, thereby resulting in widely varying quality in performance of the concluding steps of an operative procedure. In addition, even very skillful surgeons require a considerable amount of time to suture even relatively small wounds. Therefore, it is possible that an undesirable amount of blood may be lost during the suturing operation.

Accordingly, there has been an increasing tendency in recent years to use surgical staples to suture body organs and tissue after a medical procedure. Surgical staples have been particularly effective in suturing body organs and tissue such as the lung, as well as the esophagus, the stomach, the duodenum, and other body organs in the intestinal tract.

The advent of surgical stapling has provided several marked advantages over known hand suturing techniques. First, since one or more rows of surgical staples are inserted into tissue using a specially adapted instrument that is simply actuated, near uniformity of the closure from one surgeon to the next results. In addition, all staples in the closure are usually inserted simultaneously or in rapid sequence across the entire wound. Therefore, the closure is made very quickly to minimize loss of blood.

Surgical staples are usually mechanically inserted into tissue with surgical stapling instruments such as those known as anastomosis devices, including gastrointestinal anastomosis devices and transverse anastomosis devices. In such devices, the staples are loaded in one or more elongated rows into a magazine or cartridge. The magazine is then mounted in the device, which includes a mechanism for pushing, or driving, the staples from the magazine through two or more sections of tissue toward a deforming anvil. At the conclusion of the driving operation, the legs of each staple are conventionally clamped or bent, by engagement with the anvil, to a closed configuration to complete the suture and join the tissue sections together.

Gastrointestinal anastomosis-type devices drive and bend the staples aligned in a row one after the other in rapid sequence. Transverse anastomosis-type devices drive and bend all staples in a row simultaneously.

One type of conventional staple 10, shown in Figure 1, used with both gastrointestinal anastomosis and transverse anastomosis-type surgical stapling devices is made of a metal, like stainless steel or titanium, that is substantially inert in the body. The undeformed staple 10, or staple blank, is generally U-shaped and includes a back span 12 and two legs 14 depending perpendicularly from the back span in parallel to one another. Each leg 14 has a sharp chiseled end point 16 for cleanly piercing body organs or tissue. The metal staple blank is bent by having the legs engage and follow a conventional anvil to form a B-shaped closed staple 18 as shown in Figure 2.

The anvil used to bend metal surgical staples is also formed of a hardened metal and includes a staple-bending face having a pair of coined or punched pockets located to oppose each staple in the magazine of the stapling device. The pockets are ordinarily elongated arcuate depressions, co-linearly arranged in parallel to the back span of a corresponding staple held in the magazine. Thus the anvil closely resembles the anvil of a conventional paper stapler.

When the staples 10 are driven from the magazine toward the anvil, the staple legs 14 each engage one pocket so that both legs are bent toward each other initially and thereafter upwardly toward the back span 12. Thus, as shown in Figure 2, the end points 16 may come to rest against the underside of the back span 12.

Although metal staples inserted in the manner described above provide an effective and relatively simple means of suturing, one significant disadvantage is that they remain in the patient's body permanently. While generally not injurious to the body they may nevertheless interfere with post-operative X-ray or other diagnostic imaging of the patient.

This disadvantage can be overcome by using bioabsorbable polymeric staples that are degradable in the body after a short period of time. However, conventional polymeric staples are not malleable and thus cannot be easily bent into the B-shaped configuration shown in Figure 2, to complete a suture. Therefore, as shown in Figure 3, such conventional bioabsorbable staples instead are made in two parts, namely a U-shaped polymeric staple body 20, the legs 22 of which are joined by a polymeric bar-like closure 24. The closure has two end point-receiving holes 26 that fit over the end points of the staple body 20 after they have pierced the tissue to be sutured. The staple body 20 and closure 24 are then forced toward each other to complete the suture.

While this two-part staple will dissolve in the body and, therefore, does not interfere with post-operative procedures, it has the drawback of requiring a part in addition to the basic staple blank and thus requires a more complicated mechanical stapling device for properly aligning the two parts and driving them together.

More recently, a breakthrough in the bioabsorbable staple field has been made. Specifically, bioabsorbable or partially bioabsorbable surgical staples have been developed using polymeric materials. (Hereinafter the term "bioabsorbable" will be used generically to describe surgical staples of the type described in both of the applications mentioned above.) These staples retain all of the beneficial attributes of known bioabsorbable staples, but in addition are malleable or plastically deformable like metal staples. That is, these staples may be bent into complex shapes that are then retained. Therefore, they may be made of a single piece, not requiring independent staple body and closure parts.

Nevertheless, it has been found that if these new bioabsorbable staples are bent in the same way as are conventional metal staples, as shown in Figure 2, so that the chiseled end points of the staple legs hit the back span, the points may crush or break.

Therefore, improvements in surgical staples and devices for inserting them, taking advantage of the attributes of the new polymeric materials described above, are desirable.

Accordingly, it is a principle object of the present invention to enhance the benefits obtained by using malleable, bioabsorbable, polymeric staples in surgical stapling techniques.

It is a further object of the present invention to provide a malleable, bioabsorbable, polymeric staple deformed into a precise shape that securely joins tissue sections together with minimal tissue injury and damage to the staple itself.

It is another object of the present invention to provide a malleable, bioabsorbable, polymeric staple deformed into a knotted configuration to better secure the stapled tissue.

It is yet another object of the present invention to provide a malleable, bioabsorbable, polymeric staple having a variable closing force for securing the stapled tissue.

It is another object of the present invention to provide a high precision anvil for surgical stapling devices that will precisely and uniformly deform malleable, bioabsorbable, polymeric staples, as well as other staples, into a desired configuration.

It is yet another object of the present invention to provide a method for deforming the malleable, bioabsorbable, polymeric staples into the desired shape.

It is still another object of the present invention to provide a unique anvil that takes advantage of the beneficial properties of malleable, bioabsorbable, polymeric staples of the type described above to in turn provide an improved surgical stapling device.

These and other objects are achieved by the malleable, bioabsorbable, polymeric surgical staple of claim 1, by a method for using it as defined in claim 5 and by an anvil in accordance with claim 8.

It will be appreciated, of course, that the surgical stapling device anvil configured in accordance with the present invention may be used with surgical staples of any material. However, because it is specifically designed for use with malleable, bioabsorbable, polymeric staples that are non-metallic, it may be made of plastic materials that are less expensive and in which the high precision pocket-like depressions may be more easily formed than known hardened metal anvils.

These and other objects, aspects, features, and advantages of the present invention will become apparent from the following detailed description of the preferred embodiments taken in conjunction with the drawings.

Figure 1 a front elevational view of a conventional metal staple bank made, for example, of stainless steel or titanium;

Figure 2 is a front elevational view of a conventional staple in a deformed configuration;

Figure 3 is a front elevational view of a conventional two-piece bioabsorbable polymeric staple;

Figure 4 is a front elevational view of a malleable, bioabsorbable, polymeric staple in an alternative deformed state;

Figure 5 is a top plan view of the staple shown in Figure 4;

Figure 6 is a front elevational view of a malleable, bioabsorbable, polymeric staple, which is not yet deformed, in accordance with the present invention;

Figure 7 is a cross-sectional side view of a malleable, bioabsorbable, polymeric staple gripping two layers of tissue in its deformed state in accordance with the present invention;

Figure 8 is a top plan view of the staple deformed in the shape shown in Figure 7 in accordance with the present invention;

Figure 9 is a schematic perspective view of a surgical stapling device anvil formed in accordance with an embodiment of the invention;

Figure 10 is a schematic top plan view of the surgical stapling device anvil shown in Figure 9; and

Figure 11 is a vertical cross-sectional view of the surgical stapling device anvil shown in Figures 9 and 10, and taken on arcuate surface A-A in Figure 10.

As noted above, surgical staples in accordance with the present invention are made of a polymeric or plastic material. Because they are made of this unique material, these staples are plastically deformable or malleable as well as bioabsorbable. The present invention takes advantage of these unique properties to provide a surgical staple having an improved deformed configuration, a method of deforming the staple to that configuration, and a surgical stapling device anvil, the use of which results in that configuration. Of course other bioabsorbable or partially bioabsorbable malleable polymeric staples later developed may be adapted to the present invention.

An alternative malleable, bioabsorbable, plastic staple is shown in Figures 4 and 5. These figures disclose a plastic staple with legs 14' that are initially bent toward each other and then steered upwardly toward opposite sides of back span 12' to form a so-called offset B-shape. This configuration protects the brittle end points from hitting the underside of the back span. The present invention is directed to an alternative plastic staple configuration and to the method of achieving it.

More particularly, in its undeformed state shown in Figure 6, the surgical staple or staple blank 30 in accordance with the present invention is generally U-shaped as are conventional staples shown in Figure 1. Thus the improved staple 30 includes a back span 32, two legs 34, and an end point 36 formed at the extreme of each leg 34. The end points are sharply chiseled to cleanly pierce the body organs or tissue to be sutured.

Figures 7 and 8 show the plastic staple 30 in accordance with the present invention in its deformed state. The staple is shown as having pierced two layers of tissue 50 to be sutured. Each leg 34 is similarly deformed to include a bend 38, with a straight first portion 40 between the bend and the back span 32 and a curved second portion 42 at a distal end of the bend.

In deforming the staple with an anvil, which will be describe below, first bend 38 is formed at an intermediate location on each leg. As shown in Figure 7, the straight first portion extends substantially perpendicularly from the back span in a vertical, or x-axis, direction. Actually, each leg is preferably bent slightly inwardly when the bend is formed and thus forms an angle θ with the horizonal y-axis of slightly more than 90° in the x-y plane. After the bend is formed, the curved second portions are guided in the anvil toward each other and then upwardly toward the back span along a path which is arcuately curved in the horizontal plane, that is, the y-z plane in Figure 7.

As best seen in Figure 8, each curved second portion extends from the bend at an angle α of approximately 20° from the vertical x-y plane and curves back around and under the back span, thus crossing the vertical x-y plane defined by back span 32 and the first portions of legs 34. Since each leg is bent in the same manner, the legs cross the curved second portions to form a knot 44, and the end points extend through a gap between the underside of the back span and tissue layers and the bend of the opposite leg. With legs 34 deformed in this manner, the staple loosely resembles a pretzel and the configuration can be referred to as a "pretzel" or "knotted" design. One significant advantage of this design over conventionally deformed staples is that the end points of each leg are sandwiched in the gap between the back span and the bend of the opposite leg, and the curved configuration of the legs makes it difficult, if not impossible, for the staple to relax so as to slide out from the gap. Thus, the staple remains in its deformed state and a secure suture in the tissue is maintained.

Another advantage of the pretzel staple design is that, with reference to Figure 7, the end points of the legs do not pierce the tissue a second time from the underside. Rather, the gentle upward slope of the anvil deforms the second curved portions of the legs at such a slight angle that the legs can actually compress the tissue with a force against the back span. Moreover, this compression, or closing, force can be regulated by varying the stroke of the stapler against the staple in the anvil and thus the length of the straight first portion.

One type of anvil 52 used to deform the polymeric staple in accordance with the present invention is shown in Figures 9 through 11. Anvil 52 has a supporting structure 54 having a staple-receiving face 56. The face and supporting structure can be either a one or multi-piece construction.

The face 56 includes two guiding paths 58 for receiving and guiding or steering the staple legs to the desired configuration.

It will be appreciated that while the anvil shown in Figures 9 through 11 includes but one pair of guiding paths 58, in the usual case an elongated row of pairs of such pockets would be formed in a similarly elongated support structure 54 so that a large number of surgical staples can be driven simultaneously or in rapid sequence.

Guiding paths 58 curve from respective entry ends 60 to exit ends 62. The guiding paths curve relative to the horizontal plane y-z as shown in Figure 10 to bend the curved second portions of the legs as described above. As shown in Figure 11, the guiding paths 58 include a sunken pocket 64 for receiving the end points and forming the bend in each staple leg. The sunken pockets include a relief channel 66 having a width less than that of the legs. In this manner, when the legs enter the sunken pockets the end points will extend into the relief channel but will not reach its bottom surface. This protects the chiseled end points from breaking off. The guiding paths 58 slope upwardly from the sunken pockets to guide the legs toward the back span, while at the same time the horizontal curves of the guiding paths cross over each other and extend past the entry ends of the opposite guiding path so the legs are deformed into the pretzel shape as described above.

The anvil is arranged in the surgical stapling device so that longitudinal axis B-B (see Figure 10) is substantially parallel to the back span of a staple to be driven toward the anvil. Moreover, the entry ends 60 of the respective paths 58 are spaced so as to receive the respective end points 36 of the legs 34 of the staple driven toward the anvil. Accordingly, when the staple is so driven, the end points 36 each first encounter the entry end 60 of one guide path 58. As driving of the staple toward the anvil continues, the end points 36 are steered along the curved guide paths 58 to form a knot in the legs and the end points are ultimately driven within the gap formed between the underside of the back span and the bend of the opposite leg when driving is completed.

Thus it can be seen that the surgical stapling device anvil in accordance with the present invention will cause a malleable staple driven theretoward to assume a unique desired deformed configuration. Moreover, since this anvil is specifically designed to be used with malleable, bioabsorbable staples, which are made of polymeric material, it need not itself be made of a hardened material like metal. This factor is important because precisely shaped anvil pockets such as described above are difficult to form in hardened metal by other than very expensive machining techniques. Indeed coining or punching techniques for forming anvil pockets of conventional shape in known metal anvils are not suitable for forming the precisely shaped anvil pockets in accordance with the present invention. Thus plastics can be used to make the inventive anvil using precise yet inexpensive injection molding methods in the production process. Still further, plastics from which the anvil of the present invention may be made are themselves less expensive than metals used in conventional anvils. Therefore, the present invention provides significant advances over the prior art.

It has been found that polymeric materials like polycarbonate and liquid crystal polymer (LCP) may suitably be used for the inventive anvil.

As will be readily appreciated by those skilled in the art, the present invention provides marked improvements over known surgical staples and stapling device anvils. It achieves all of the benefits of known bioabsorbable, polymeric staples without the associated drawbacks. Moreover, by taking advantage of the unique properties of recently developed malleable, bioabsorbable, polymeric staples, this invention provides a unique deformed staple shape, as well as a unique surgical stapling device anvil structure and method for producing that shape.

Claims

1. A deformed malleable, bioabsorbable polymeric surgical staple, comprising:

    a back span (32); and
    first and second legs (34) extending in a first direction from opposite ends of said back span (32), each of said first and second legs (34) terminating in an end point (36), wherein
    each leg includes a bend (38) and a curved portion (42), which extends from said bend (38) at a distal end of said leg and across a vertical plane, extending in the first direction and through said back span, with the curved portions of each respective leg (34) crossing with each other, characterized in that the curved portion (42) is curved back in the opposite sense to the bend (38).

2. A deformed malleable, bioabsorbable polymeric surgical staple according to Claim 1 wherein each said end point (36) extends between said bend (38) in an opposite leg (34) and an underside of said back span (32).

3. A deformed malleable, bioabsorbable polymeric surgical staple according to Claim 2, wherein each said leg (34) comprises a straight portion (40) between said bend (38) and said back span (32), with said straight portion (40) extending substantially perpendicularly from said back span (32).

4. A deformed malleable, bioabsorbable polymeric surgical staple according to Claim 3, wherein said curved portion (42) extends toward an opposite leg and upwardly toward said back span (32).

5. A method of deforming a malleable, bioabsorbable, polymeric surgical staple having a back span (32), first and second legs (34) extending in a first direction from opposite ends of the back span (32) and substantially perpendicularly thereto in an undeformed state, the first and second legs (34) each terminating in an end point (36); said method comprising the steps of:

    initially deforming the first and second legs (34) inwardly toward each other to form a bend (38) in each leg (34), with each leg having a straight portion (40) between the back span (32) and the bend (38); and
    thereafter deforming in each leg (32) a curved portion (42) leading from the bend (38) and extending to the end point (36) in an arcuate shape curved back in the opposite sense of the bend (38) and extending across a vertical plane, defined in the first direction and passing through the back span (32), with the curved portions (42) of each leg (32) crossing each other.

6. A method according to Claim 5, further comprising the step of deforming the curved portions (42) of each leg (32) so the respective end points (36) extend between the bend (38) in an opposite leg (34) and an underside of the back span (32).

7. A method according to Claim 6, further comprising the step of regulating a deforming force initially applied to the staple to adjust a length of the straight portion (40) of each leg (34).

8. An anvil for deforming a malleable surgical staple having a back span (32), and first and second legs (34) extending in one direction from opposite ends of the back span (32) and substantially perpendicu-

larly thereto in an undeformed state and each leg including a bend (38) and a curved portion (42), which extends from said bend (38) at a distal end of said leg and across a vertical plane, extending in the first direction and through said back span, said anvil comprising:

a supporting body (54) having a longitudinal axis and including a staple-receiving face (56) in a horizontal plane;
first and second pocket depressions (58) each beginning with an entry end (60) located at said staple-receiving face (56), continuing to a depressed portion (64) within said body below said staple-receiving face (56), and terminating in an exit end (62) at said staple-receiving face (56), said first and second pocket depressions (58) each having an arcuate portion and extending in non-collinear relation with the entry end (60) of each located substantially on the longitudinal axis and the exit end (62) of each located on a side of the longitudinal axis opposite the side on which the exit end (62) of the other pocket depression (58) is located, with said arcuate portions curving to form a bend and crossing each other approximately at the longitudinal axis, wherein
the first and second legs (32) of a staple driven toward said anvil and received in the entry ends (60) of the respective first and second pocket depressions (58) are guided to the exit ends (62) thereof to be deformed toward the back span (32) and formed such that distal ends (36) of the first and second legs (34) extend between a bend (38) in the opposite leg (34) and the back span (32), whereby the curved portion (42) is curved back in the opposite sense to the bend (38).

9. An anvil according to Claim 8, wherein said first and second pocket depressions (58) include a relief channel (66) for receiving end points (36) of the staple legs (34), said relief channels (66) having a width less than that of the staple legs (34) so the end points cannot touch a bottom surface thereof.

10. An anvil according to Claim 9, wherein said supporting body (54) and said pocket depressions (58) therein are formed of injection-molded plastic.

Patentansprüche

1. Eine verformte schmiedbare bioabsorbiere Operationsklammer auf Polymerbasis mit:

einer hinteren Spanne (32); und
ersten und zweiten Beinen (34), die in einer ersten Richtung von entgegengesetzten Enden der hinteren Spanne (32) ausgehen, wobei jedes der ersten und zweiten Beine (34) in einem Endpunkt (36) endet, bei der
jedes Bein eine Biegung (38) und einen gebogenen Abschnitt (42) enthält, der sich von der Biegung (38) an einem Distalende des Beins und über eine vertikale Ebene erstreckt, in der ersten Richtung und durch die hintere Spanne verlaufend, wobei die gebogenen Abschnitte jedes jeweiligen Beins (34) einander kreuzen, dadurch gekennzeichnet, daß der gebogene Abschnitt (42) im entgegengesetzten Sinn zur Biegung (38) zurückgebogen ist.

2. Eine verformte schmiedbare bioabsorbierbare Operationsklammer auf Polymerbasis nach Anspruch 1, bei der sich jeder Endpunkt (36) zwischen der Biegung (38) in einem gegenüberliegenden Bein (34) und einer Unterseite der hinteren Spanne (32) erstreckt.

3. Eine verformte schmiedbare bioabsorbierbare Operationsklammer auf Polymerbasis nach Anspruch 2, bei der jedes Bein (34) einen geraden Abschnitt (40) zwischen der Biegung (38) und der hinteren Spanne (32) aufweist, wobei der gerade Abschnitt (40) im wesentlichen senkrecht von der hinteren Spanne (32) ausgeht.

4. Eine verformte schmiedbare bioabsorbierbare Operationsklammer auf Polymerbasis nach Anspruch 3, bei der sich der gebogene Abschnitt (42) zu einem gegenüberliegenden Bein und nach oben zur hinteren Spanne (32) erstreckt.

5. Ein Verfahren zum Verformen einer schmiedbaren bioabsorbierbaren Operationsklammer auf Polymerbasis mit einer hinteren Spanne (32), ersten und zweiten Beinen (34), die von entgegengesetzten Enden der hinteren Spanne (32) in einer ersten Richtung ausgehen und sich in einem nicht verformten Zustand im wesentlichen senkrecht dazu erstrecken, wobei die ersten und zweiten Beine (34) jeweils in einem Endpunkt (36) enden; wobei das Verfahren die Schritte umfaßt:

anfängliches Verformen der ersten und zweiten Beine (34) einwärts aufeinander zu, um eine Biegung (38) in jedem Bein (34) zu bilden, wobei jedes Bein einen geraden Abschnitt (40) zwischen der hinteren Spanne (32) und der Biegung (38) aufweist; und
danach Verformen eines gebogenen Abschnitts (42) in jedem Bein (34), der von der Biegung (38) wegführt und sich zu dem Endpunkt (36) in einer gebogenen Form erstreckt, die im entgegengesetzten Sinn der Biegung (38) zurückgebogen ist, und sich über eine vertikale Ebene erstreckt, die in der ersten Richtung definiert ist und durch die hintere Spanne

(32) durchgeht, wobei die gebogenen Abschnitte (42) jedes Beins (34) einander kreuzen.

6. Ein Verfahren nach Anspruch 5, ferner aufweisend den Schritt Verformen der gebogenen Abschnitte (42) jedes Beins (34), so daß sich die jeweiligen Endpunkte (36) zwischen der Biegung (38) in einem gegenüberliegenden Bein (34) und einer Unterseite der hinteren Spanne (32) erstrecken.

7. Ein Verfahren nach Anspruch 6, ferner aufweisend den Schritt Regulieren einer anfangs auf die Klammer angewandten Verformkraft, um eine Länge des geraden Abschnitts (40) jedes Beins (34) einzustellen.

8. Ein Amboß zum Verformen einer schmiedbaren Operationsklammer mit einer hinteren Spanne (32) und ersten und zweiten Beinen (34), die in einer ersten Richtung von entgegengesetzten Enden der hinteren Spanne (32) ausgehen und sich in einem nicht verformten Zustand im wesentlichen senkrecht dazu erstrecken, und wobei jedes Bein eine Biegung (38) und einen gebogenen Abschnitt (42) enthält, der sich von der Biegung (38) an einem Distalende des Beins und über eine vertikale Ebene erstreckt, die sich in der ersten Richtung und durch die hintere Spanne erstreckt, wobei der Amboß aufweist:

   einen Auflagekörper (54), der eine Längsachse aufweist und eine klammeraufnehmende Fläche (56) in einer horizontalen Ebene enthält;
   erste und zweite Taschenvertiefungen (58), die jeweils mit einem an der klammeraufnehmenden Fläche (56) gelegenen Eintrittsende (60) beginnen, sich zu einem vertieften Abschnitt (64) innerhalb des Körpers unter der klammeraufnehmenden Fläche (56) fortsetzen und in einem Austrittsende (62) bei der klammeraufnehmenden Fläche (56) enden, wobei die ersten und zweiten Taschenvertiefungen (58) jeweils einen bogenförmigen Abschnitt aufweisen und sich in nicht-kollinearer Beziehung erstrecken, wobei jedes Eintrittsende (60) im wesentlichen auf der Längsachse liegt und jedes Austrittsende (62) auf einer Seite der Längsachse liegt, die der Seite gegenüberliegt, auf der das Austrittsende (62) der anderen Taschenvertiefung (58) liegt, wobei sich die bogenförmigen Abschnitte krümmen, um eine Biegung auszubilden und einander etwa bei der Längsachse zu kreuzen, wobei
   die ersten und zweiten Beine (34) einer Klammer, die zum Amboß hin getrieben und in den Eintrittsenden (60) der jeweiligen ersten und zweiten Taschenvertiefungen (58) aufgenommen wird, zu deren Austrittsenden (62) geführt werden, um zur hinteren Spanne (32) hin verformt und so geformt zu werden, daß sich Distalenden (36) der ersten und zweiten Beine (34) zwischen einer Biegung (38) im gegenüberliegenden Bein (34) und der hinteren Spanne (32) erstrecken, wodurch der gebogene Abschnitt (42) im entgegengesetzten Sinn zur Biegung (38) zurückgebogen wird.

9. Ein Amboß nach Anspruch 8, bei dem die ersten und zweiten Taschenvertiefungen (58) einen Aussparungskanal (66) zum Aufnehmen von Endpunkten (36) der Klammerbeine (34) enthalten, wobei die Aussparungskanäle (66) eine Breite haben, die geringer als die der Klammerbeine (34) ist, so daß die Endpunkte deren Bodenfläche nicht berühren können.

10. Ein Amboß nach Anspruch 9, bei dem der Auflagekörper (54) und die Taschenvertiefungen (58) darin aus einem spritzgußgeformten Kunststoff geschaffen sind.

Revendications

1. Agrafe chirurgicale polymérique malléable, bioabsorbable déformée, comportant :

   une traverse formant dos (32) ; et
   des première et seconde pattes (34) s'étendant dans une première direction à partir des extrémités opposées de ladite traverse formant dos (32), chacune desdites première et seconde pattes (34) se terminant en une pointe d'extrémité (36), dans laquelle
   chaque patte comporte une courbure (38) et une partie incurvée (42), qui s'étend à partir de ladite courbure (38) au niveau d'une extrémité distale de ladite patte et à travers un plan vertical, s'étendant dans la première direction et à travers ladite traverse formant dos, les parties incurvées de chaque patte respective (34) se recoupant l'une avec l'autre, caractérisée en ce que la partie incurvée (42) est incurvée en arrière dans la direction opposée à la courbure (38).

2. Agrafe chirurgicale polymérique malléable, bioabsorbable déformée, selon la revendication 1, dans laquelle chacune desdites pointes d'extrémité (36) s'étend entre ladite courbure (38) d'une patte opposée (34) et un côté de dessous de ladite traverse formant dos (32).

3. Agrafe chirurgicale polymérique malléable, bioabsorbable déformée, selon la revendication 2, dans laquelle chacune desdites pattes (34) comporte une partie rectiligne (40) située entre ladite courbure (38) et ladite traverse formant dos (32),

ladite partie rectiligne (40) s'étendant à peu près perpendiculairement à partir de ladite traverse formant dos (32).

4. Agrafe chirurgicale polymérique malléable, bio-absorbable déformée, selon la revendication 3, dans laquelle ladite partie incurvée (42) s'étend vers une patte opposée et vers le haut vers ladite traverse formant dos (32).

5. Procédé de déformation d'une agrafe chirurgicale polymérique malléable, bio-absorbable, ayant une traverse formant dos (32), des première et seconde pattes (34) s'étendant dans une première direction à partir des extrémités opposées de la traverse formant dos (32) et à peu près perpendiculairement à celle-ci dans un état non-déformé, les première et seconde pattes (34) se terminant chacune en une pointe d'extrémité (36) ; ledit procédé comportant les étapes consistant à :

déformer initialement les première et seconde pattes (34) vers l'intérieur l'une vers l'autre pour former une courbure (38) dans chaque patte (34), chaque patte ayant une partie rectiligne (40) entre la traverse formant dos (32) et la courbure (38) ; et
déformer après ceci dans chaque patte (32) une partie incurvée (42) partant de la courbure (38) et s'étendant vers la pointe d'extrémité (36) selon une forme en arc de cercle incurvée vers l'arrière dans la direction opposée à la courbure (38) et s'étendant à travers un plan vertical, défini dans la première direction et passant à travers la traverse formant dos (32), les parties incurvées (42) de chaque patte (32) se croisant l'une avec l'autre.

6. Procédé selon la revendication 5, comportant de plus l'étape consistant à déformer les parties incurvées (42) de chaque patte (32) de sorte que les pointes d'extrémité respectives (36) s'étendent entre la courbure (38) d'une patte opposée (34) et un côté de dessous de la traverse formant dos (32).

7. Procédé selon la revendication 6, comportant de plus l'étape consistant à réguler la force de déformation initialement appliquée à l'agrafe pour régler la longueur de la partie rectiligne (40) de chaque patte (34).

8. Enclume pour déformer une agrafe chirurgicale malléable ayant une traverse formant dos (32), des première et seconde pattes (34) s'étendant dans une direction à partir des extremités opposées de la traverse formant dos (32) et à peu près perpendiculairement à celle-ci dans un état non-déformé, et chaque patte comportant une courbure (38) et une partie incurvée (42), qui s'étend à partir de ladite courbure (38) au niveau d'une extrémité distale de ladite patte et à travers un plan vertical, s'étendant dans la première direction et à travers ladite traverse formant dos, ladite enclume comportant :

un corps de support (54) ayant un axe longitudinal et comportant une face de réception d'agrafe (56) située dans un plan horizontal ;
des premier et second enfoncements formant poche (58) commençant chacun par une extrémité d'entrée (60) située au niveau de ladite face de réception d'agrafe (56), se poursuivant vers une partie enfoncée (64) située dans ledit corps en-dessous de ladite face de réception d'agrafe (56), et se terminant en une extrémité de sortie (62) située au niveau de ladite face de réception d'agrafe (56), lesdits premier et second enfoncements formant poche (58) ayant chacun une partie en arc de cercle et s'étendant selon une relation non-colinéaire avec l'extrémité d'entrée (60) de chacun située à peu près sur l'axe longitudinal, et l'extrémité de sortie (62) de chacun étant située sur un côté de l'axe longitudinal opposé au côté sur lequel l'extrémité de sortie (62) de l'autre enfoncement formant poche (58) est située, lesdites parties en arc de cercle s'incurvant pour former une courbure et se croisant l'une avec l'autre approximativement au niveau de l'axe longitudinal, dans laquelle
les première et seconde pattes (32) d'une agrafe entraînée vers ladite enclume et reçue dans lesdites extrémités d'entrée (60) des premier et second enfoncements formant poche (58) respectifs sont guidées vers les extrémités de sortie (62) de ceux-ci pour être déformées vers la traverse formant dos (32), et formées de telle sorte que les extrémités distales (36) des première et seconde pattes (34) s'étendent entre une courbure (38) de la patte opposée (34) et la traverse formant dos (32), de sorte que la partie incurvée (42) est incurvée en arrière dans la direction opposée à la courbure (38).

9. Enclume selon la revendication 8, dans laquelle lesdits premier et second enfoncements formant poche (58) comportent un canal en creux (66) pour recevoir des pointes d'extrémités (36) des pattes d'agrafes (34), lesdits canaux en creux (66) ayant une largeur inférieure à celle des pattes d'agrafe (34) de sorte que les pointes d'extrémité ne peuvent pas toucher la surface inférieure de ceux-ci.

10. Enclume selon la revendication 9, dans laquelle ledit corps de support (54) et lesdits enfoncements formant poche (58) situés dans celui-ci sont constitués d'une matière plastique moulée par injection.

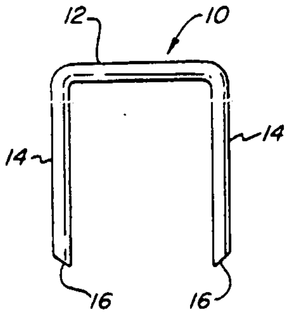

FIG. 1
(PRIOR ART)

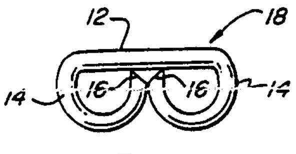

FIG. 2
(PRIOR ART)

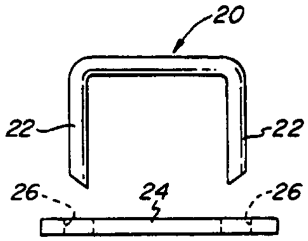

FIG. 3
(PRIOR ART)

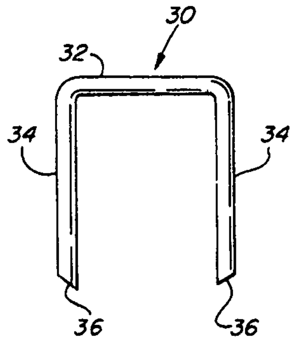

FIG. 6

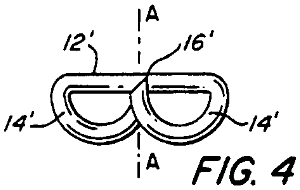

FIG. 4

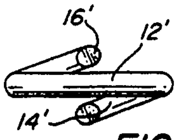

FIG. 5

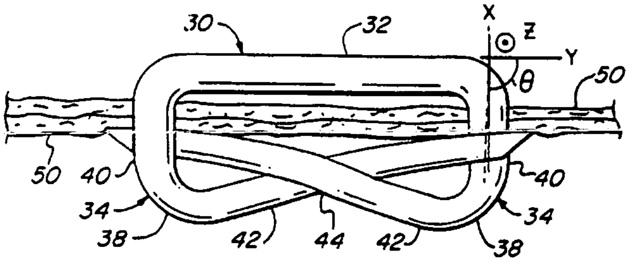

FIG. 7

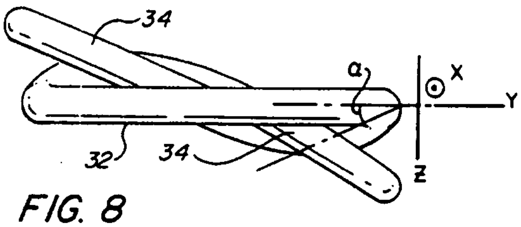

FIG. 8

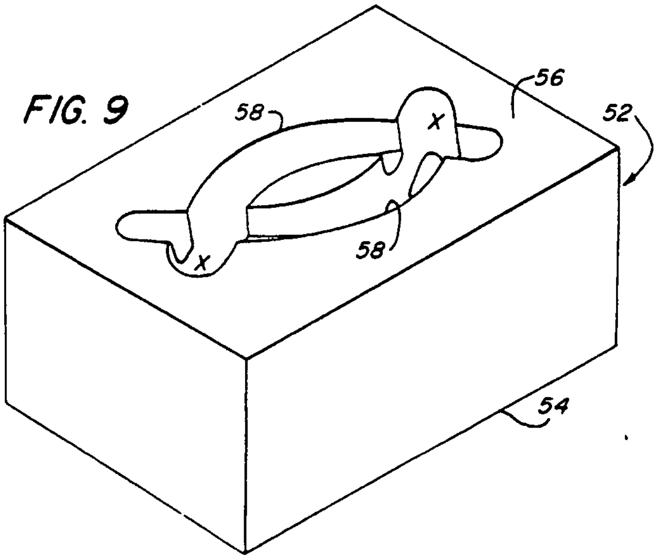
FIG. 9

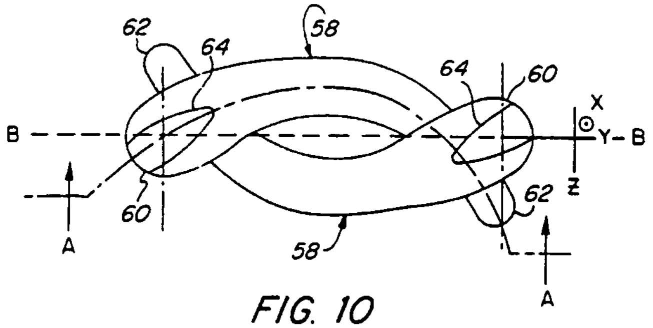

FIG. 10

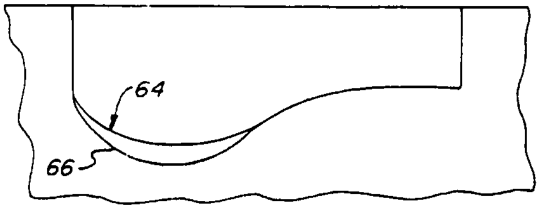

FIG. 11